PERFORMANCE WORK STATEMENT ATTACHMENT

EPA Contract:	EP-C-12-011
Work Assignment (WA):	2-04
Contractor:	ICF International 9300 Lee Highway Fairfax, VA 22031-1207
Statement of Work Title:	Aerodynamic Trailer Component Assessment and Impact on the Green House Gas Emissions from Heavy-Duty Combination Vehicles
Work Assignment Contract Officer Representative (WA COR):	Arvon Mitcham 2000 Traverwood Drive Ann Arbor, MI 48105 734-214-4522 mitcham.arvon@epa.gov
Alternate WA COR:	Houshun Zhang 2000 Traverwood Drive Ann Arbor, MI 48105 734-214-4214 zhang.houshun@epa.gov
Purpose:	Detailed Test Plans for ICF Contract #EP-C-12-011, WA #2-04: • Attachment A: Coastdown/Constant Speed Test Specifications and Vehicle Configurations • Attachment B: Reduced Scale Wind Tunnel Test Specifications and Model Configurations

ATTACHMENT A

DETAILED TEST PLAN FOR ON-ROAD TESTING

Detailed Test Plan for Task 2a: On-Road Evaluation of Full-Size Class 7/8 Tractor-Trailer Combinations with and without Aerodynamic Trailer Devices using Coastdown Test Procedures

High Roof Sleeper Cabs									
Tractors (n=2)	**Trailers (n=1)**	**Devices (individually and combined, n=3)**	**Bogey Position**	**Tractor to Trailer Gap in inches**	**King Pin Setting**	**Trailer Radius**	**Trailer Ride Height Front/ Leading Edge**	**Trailer Ride Height Rear/ Trailing Edge**	**Trailer Test Weight**
MY2012 Navistar Pro Star High Roof Sleeper Cab	2008/09 Wabash	Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	40’	45”	36”	5”	13’6”	13’6”	Empty
2012 Volvo VNL780 High Roof Sleeper Cab 2012 Navistar ProStar High Roof Day Cab	2008/09 Wabash	None (Base Trailer)	40’	45”	36”	5”	13’6”	13’6”	Empty
		Silver Eagle Aero Saber Trailer Skirt	40’	45”	36”	5”	13’6”	13’6”	Empty
		Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	40’	45”	36”	5”	13’6”	13’6”	Empty

Trailer: All trailers must be 53' dry box vans with swing doors, king pin at 36", front corner radius 5" with air ride.
Yaw Map: Not applicable; however, we would like to use an ultrasonic anemometer or special wedge probe to investigate on-vehicle, localized wind/speed measurement for developing an on-road yaw sweep curve.
Tractor-Trailer Specifications: California position of a standard bogey is defined as 40' from the center of the king pin to the center of the rear most axle on the trailer.
Tractor-trailer gap is 45 inches and is defined as and measured from the rear of the tractor to the front of the trailer.
All coastdown testing shall be performed using the modified J1263 coastdown procedure except that the speed range shall be modified to be 70 to 0 mph rather than 70 to 15 mph.
Equipment: ultrasonic anemometer shall be used and mounted to the trailer. Also, the use of an airflow wedge probe and other, additional trackside anemometers may be used.
Test Procedure Specifications: All coastdown testing shall be performed using the coastdown procedure except that the speed range shall be modified to be 70 to 0 mph rather than 70 to 15 mph. Also, the use of an airflow wedge/static probe and other, additional trackside anemometers may be used.

ATTACHMENT A

DETAILED TEST PLAN FOR ON-ROAD TESTING

Detailed Test Plan for Task 2b: On-Road Evaluation of Full-Size Class 7/8 Tractor-Trailer Combinations with and without Aerodynamic Trailer Devices using Constant Speed Test Procedures

Tractors (n=2)	Trailers (n=1)	Devices (individually and combined, n=1)	Bogey Position	Tractor to Trailer Gap in inches	King Pin Setting	Trailer Radius	Trailer Ride Height Front/ Leading Edge	Trailer Ride Height Rear/ Trailing Edge	Trailer Test Weight
MY2012 Navistar Pro Star High Roof Sleeper Cab	2008/09 Wabash	Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	40’	45”	36”	5”	13’6”	13’6”	Empty
2012 Volvo VNL780 High Roof Sleeper Cab 2012 Navistar ProStar High Roof Day Cab	2008/09 Wabash	Silver Eagle Aero Saber Trailer Skirt	40’	45”	36”	5”	13’6”	13’6”	Empty
		*None (Base Trailer)							
		*Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail							

Trailer: All trailers must be 53' dry box vans with swing doors, king pin at 36", front corner radius 5" with air ride.
Yaw Map: Not applicable; however, we would like to use a special wedge probe to investigate on-vehicle, localized wind/speed measurement for developing an on-road yaw sweep curve.
Tractor-Trailer Specifications: California position of a standard bogey is defined as 40' from the center of the king pin to the center of the rear most axle on the trailer.
Tractor-trailer gap is 45 inches and is defined as and measured from the rear of the tractor to the front of the trailer.
Equipment: The contractor shall also use a driveshaft torque sensor (strain gauge) to measure torque during the testing each of the trucks. The torque sensors shall be calibrated according to procedure stated in §1065.310. Ultrasonic anemometer shall be used and mounted to the trailer. Also, the use of an airflow wedge probe and other, additional trackside anemometers may be used.
Test Procedure Specifications: The contractor shall warm-up the vehicle 30min-1 hour at 65mph prior to each day testing. Warm up Is not required between model/configuration changes provided that: 1) they occur on the same day as the warm-up procedure (i.e., testing performed on the next day requires a warm-up procedure); 2) the track and tires are and remain dry during testing to reduce error introduced via rolling resistance and condensation (i.e., if testing is halted due to wet weather conditions, a sufficient amount of warm up should be performed to ensure that the track surface is dry); and 3) no instrument errors have occurred (i.e., if instrumentation fails during testing, a warm-up procedure must be performed following instrumentation repair/replacement). The test requires making two laps (one run in each direction) of 1 mile in length at steady state speeds in this order: 70, 10, 20, 30, 40, 50, 60, 70, 60, 50, 40, 30, 20, 10, 70 mph while recording torque and engine power OBD information.

* *The contractor shall only perform testing of these configurations after receipt of written technical direction from the EPA WA COR.*

ATTACHMENT B

DETAILED TEST PLAN FOR REDUCED-SCALE WIND TUNNEL TESTING

Detailed Test Plan for Task 3: Reduced-Scale Wind Tunnel Evaluation of 1/8th (12.5%) Scale Class 7/8 Tractor-Trailer Combinations with and without Aerodynamic Trailer Devices

Tractors (n=4)	Trailers (n=3)	Devices (individually and combined, n=7)	Bogey Position	Tractor to Trailer Gap in inches	King Pin Setting	Trailer Radius	Trailer Ride Height Front/ Leading Edge	Trailer Ride Height Rear/ Trailing Edge	Trailer Test Weight
2012 Freightliner Cascadia 2012 Kenworth T700 2012 Navistar Pro Star 2012 Volvo VNL780 High Roof Day Cab	2008/09 Wabash 200x Great Dane 200x Hyundai Translead	None (Base Trailer)	40’	45”	36”	5”	13’6”	13’6”	Empty
		Silver Eagle Aero Saber Trailer Skirt	40’	45”	36”	5”	13’6”	13’6”	Empty
		Ridge Green Wing Trailer Skirt	40’	45”	36”	5”	13’6”	13’6”	Empty
		AT Dynamics Trailer Tail	40’	45”	36”	5”	13’6”	13’6”	Empty
		Laydon Composites Gap Reducer	40’	45”	36”	5”	13’6”	13’6”	Empty
		Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail	40’	45”	36”	5”	13’6”	13’6”	Empty
		Silver Eagle Aero Saber Trailer Skirt + AT Dynamics Trailer Tail + Laydon Composites Gap Reducer	40’	45”	36”	5”	13’6”	13’6”	Empty

Trailer: All trailers must be 53' dry box vans with swing doors, king pin at 36", front corner radius 5" with air ride.
Yaw Map: All testing to be done with full yaw sweeps of 0, -9, -6, -3, -1, 0, +1, +3, +6, +9, 0 and wind average drag calculations at calculations at all speeds between 55-75 mph in increments of 10 mph (e.g., 55, 65, 75). Alternatively, a half yaw sweep (0, +1, +3, +6, +9) or 0,+/-6 may be used to develop the yaw sweep.
Tractor-Trailer Specifications: California position of a standard bogey is defined as 40' from the center of the king pin to the center of the rear most axle on the trailer. Tractor-trailer gap is 45 inches and is defined as and measured from the rear of the tractor to the front of the trailer.
Test Procedure Specifications: All reduced-scale wind tunnel testing shall be performed using the test procedure described in §1037.521(d) of Title 40 to obtain estimates of aerodynamic drag, unless otherwise specified.
All testing shall be performed with a dual balance load cell to capture the aerodynamic drag split between tractor and trailer.
All test parameters (e.g., Reynolds number, wind speed, simulated vehicle speed, humidity, temperature, pressures, any correction factors) shall be collected and provided for each test to ensure accuracy, repeatability and validity.
All testing shall be consistent with 40 CFR §86.1037.521.